# Sanitary Sewer System Modeling Analyses

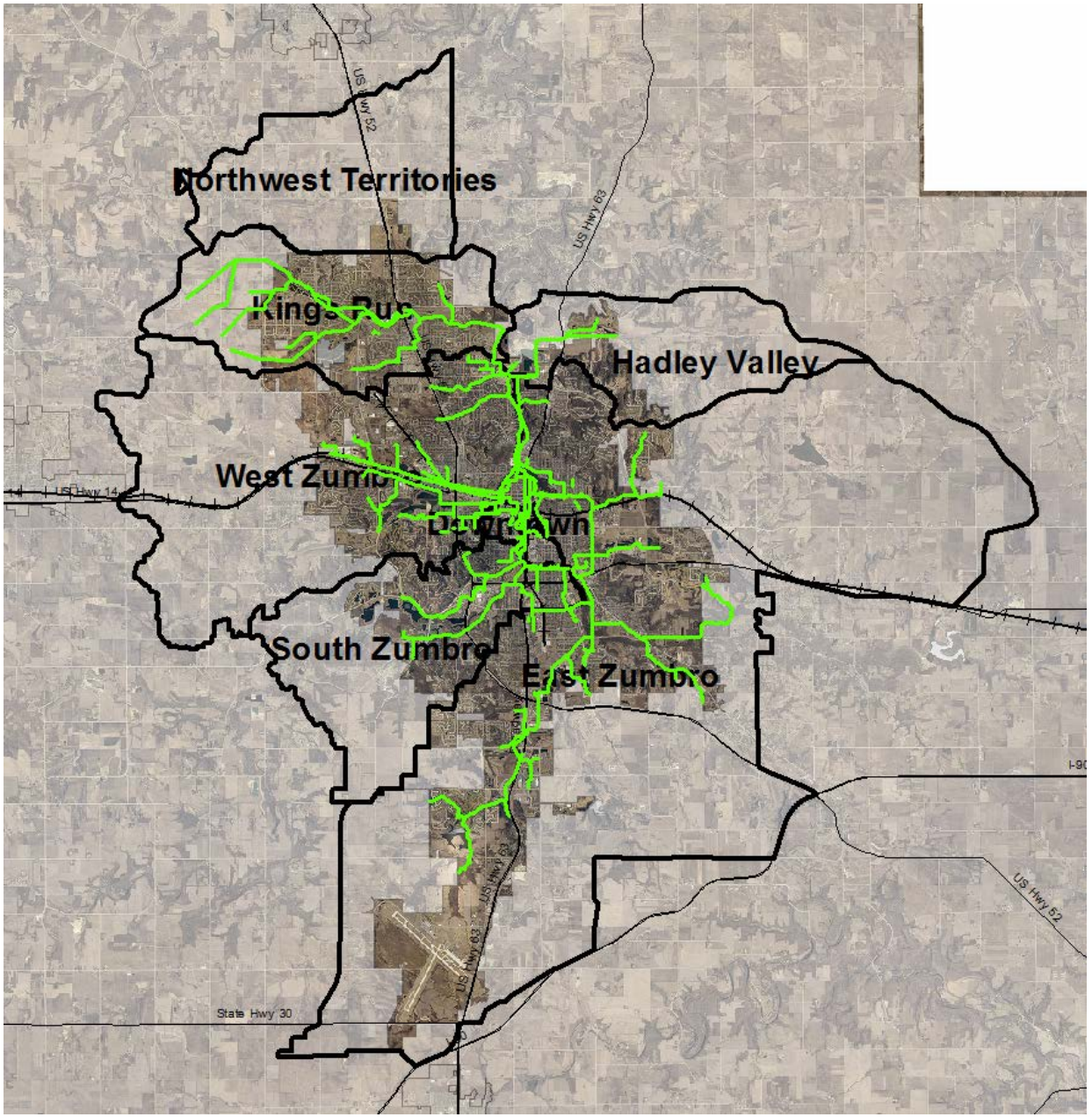
Rochester City Council
Committee of the Whole
March 20, 2017

# Introductions

## Presentation Topics

- ✓ 01 Sanitary Sewer System Model Development and Analysis
- ✓ 02 Sewer Analysis Findings
- ✓ 03 City Comprehensive Plan and the Impacts of Sanitary Sewer Capacity
- ✓ 04 Next Steps

# City Currently has over 500,000 feet of Trunk Sewer Main



## THE WHY

- System Analysis – 500,000 linear feet of trunk (≥ 12”) sewer lines
- Last Comprehensive System-wide Review in 1996
- Numerous Projects Constructed from 1997-2016
- Numerous Projects Remaining
- New Technology and Software Tools Available
- Issues/concerns
  - Current constraints (I/I, capacity, etc.)
  - Redevelopment/additional development capacity limitations
  - Prioritization
    - Fix the worst first
    - Replace based on economic benefit
    - Growth Management based on sewer capacity availability / limitations
  - Right sizing/timing
    - Pipe-lining maintains current capacity and replacement can add capacity

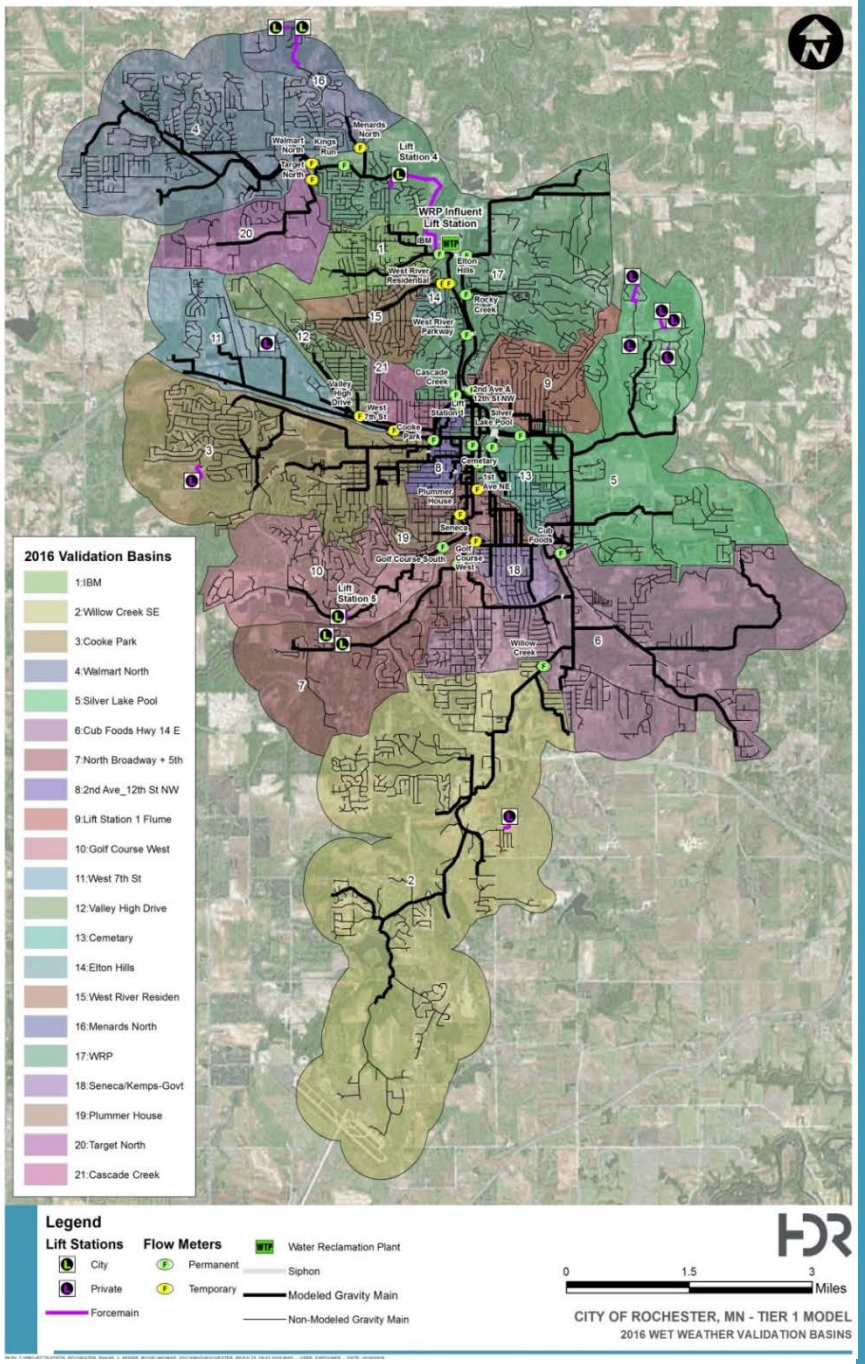
# 01 Sanitary Sewer Model Development and Analyses

# Modeling Objectives & Benefits

- Refine/validate previous study results from 1996
- Create model of Tier 1 trunk (≥12-inch) sanitary system
- Identify sewer system capacity availability and limitations
- Assess past sewer system improvements
- Fully dynamic model simulates system flow conditions
- Robust planning and comparison capability – predictive ‘what-if’ scenarios
- Optimize CIP schedule and budgeting for future growth

# Model Development Process Leads to *Efficient* Capital Planning

- Sewer system data gap analysis
- Selection of appropriate modeling software
- Model development using City's GIS
- Model calibration/validation using City's flow meters/data
- Analyze existing and future capacity
- Analyze future conditions scenarios for capital improvements planning
- Identify trunk sewer system improvements

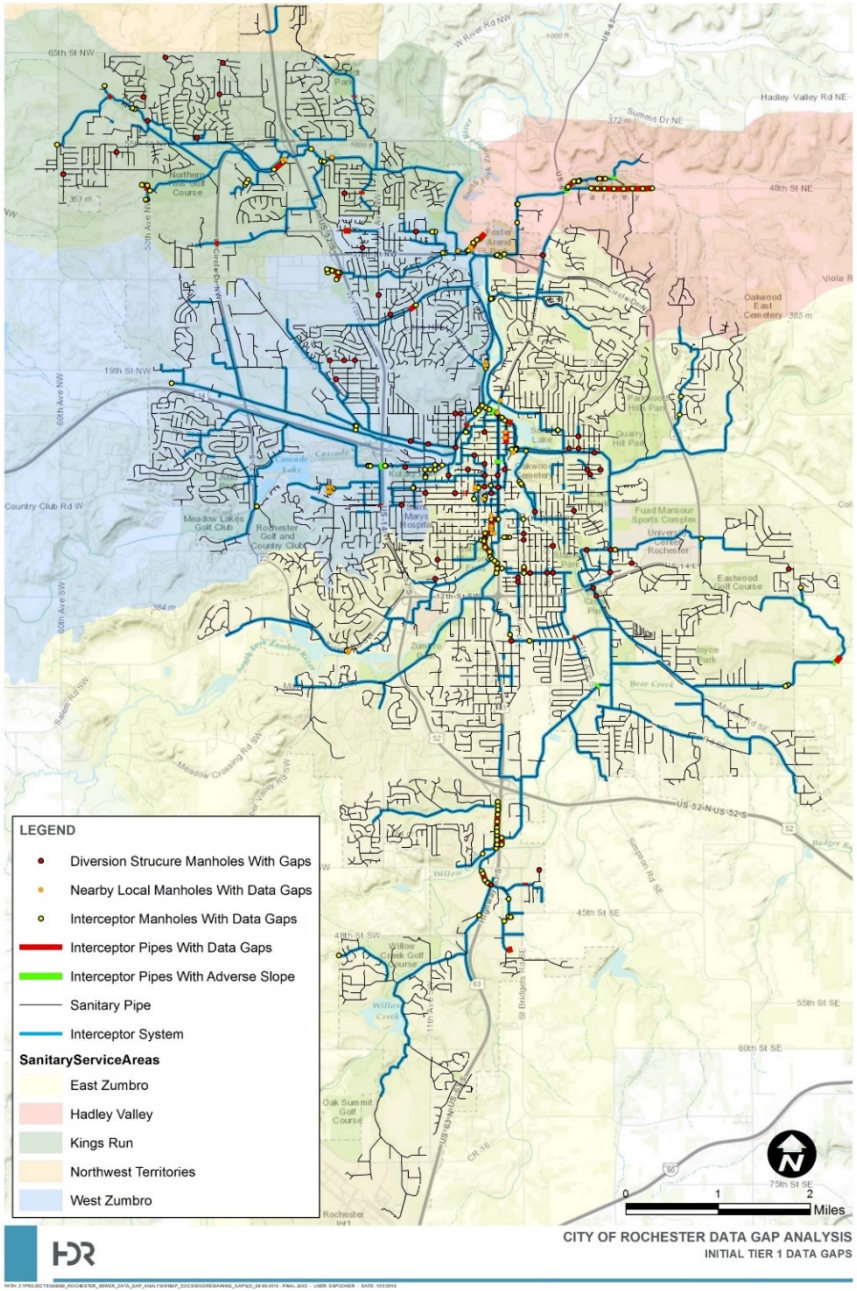



Model Validation Basins with Flow Monitors

# Data Gap Analysis Prepares City for Modeling

- Completed prior to model development
- Review years of flow meter data
- Inventory of existing asset data
- Identify data gaps/needs
- Allowed for efficient data collection and incorporation into model
- Selection of appropriate model software

*Available City data was well-suited for efficient and robust model development*

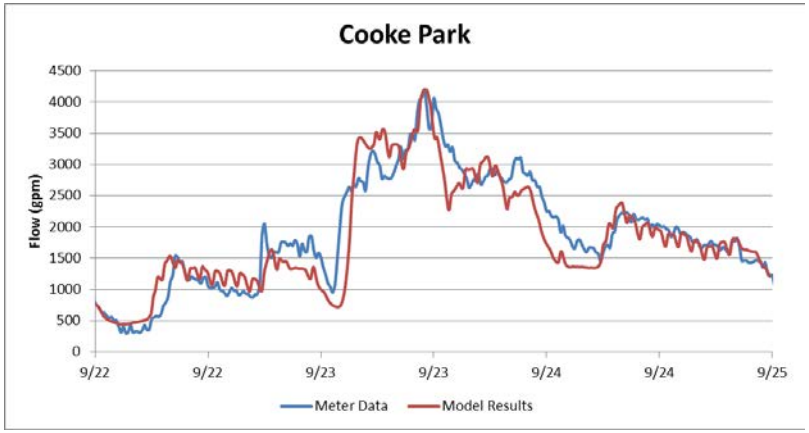


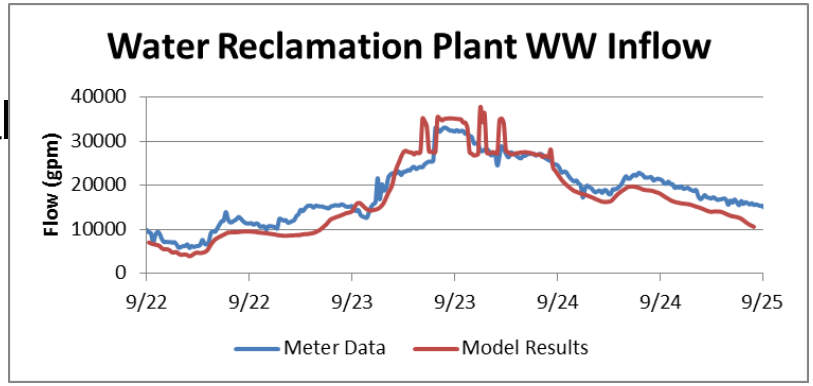

Map of Initially Identified Data Gaps

# Model Development Calibration and Validation Results

- Validated Model to 3 rainstorm events
  - September 2010
    - 25-Year Storm
  - July 2011
    - 10-Year Storm
  - July 2016
- Adjust model parameters to represent actual field measured flow conditions
- Overall a very good match between flow monitoring and model results

*Provides confidence in model's ability to predict system response*

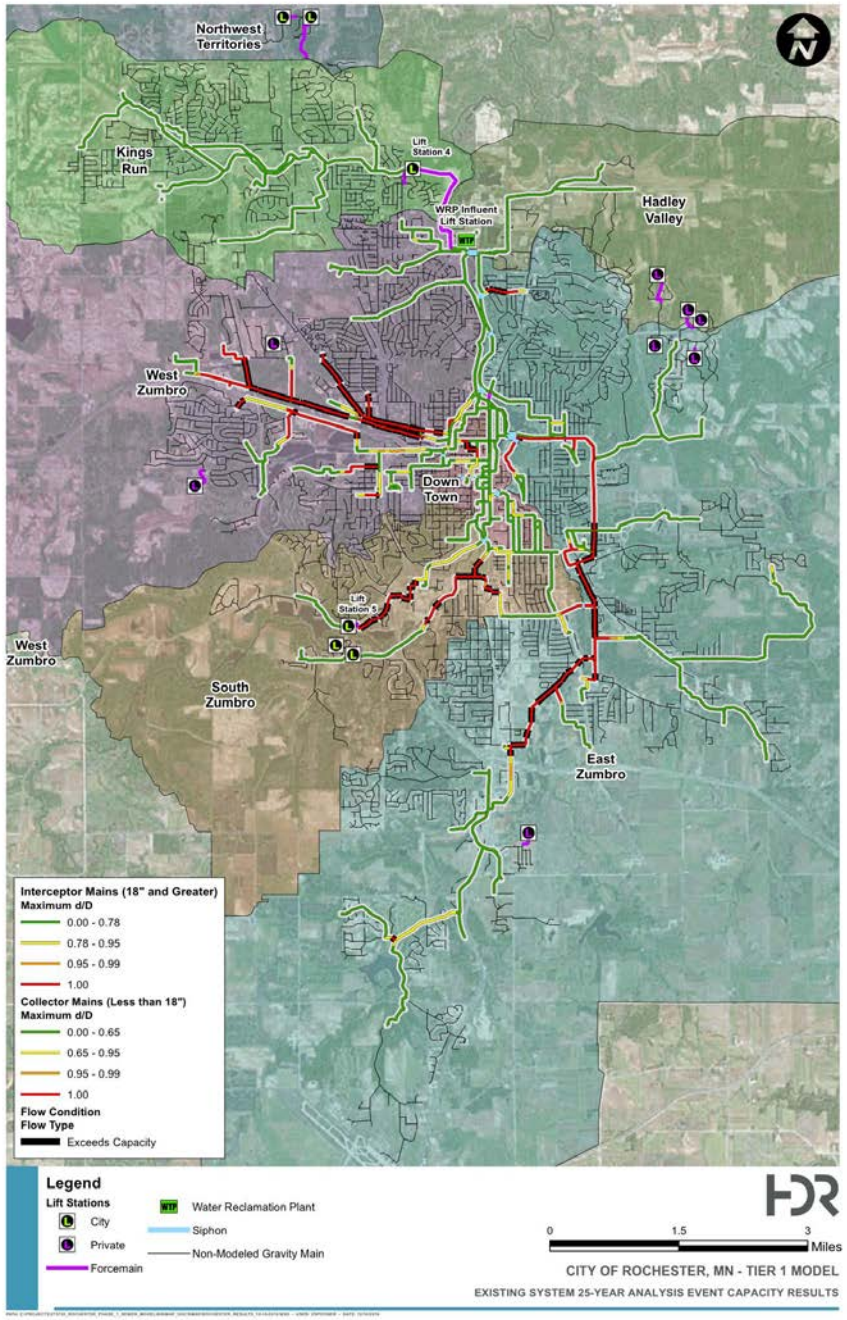



Graphs comparing 'actual' vs. 'modeled' flows

# Existing Sewer System Capacity

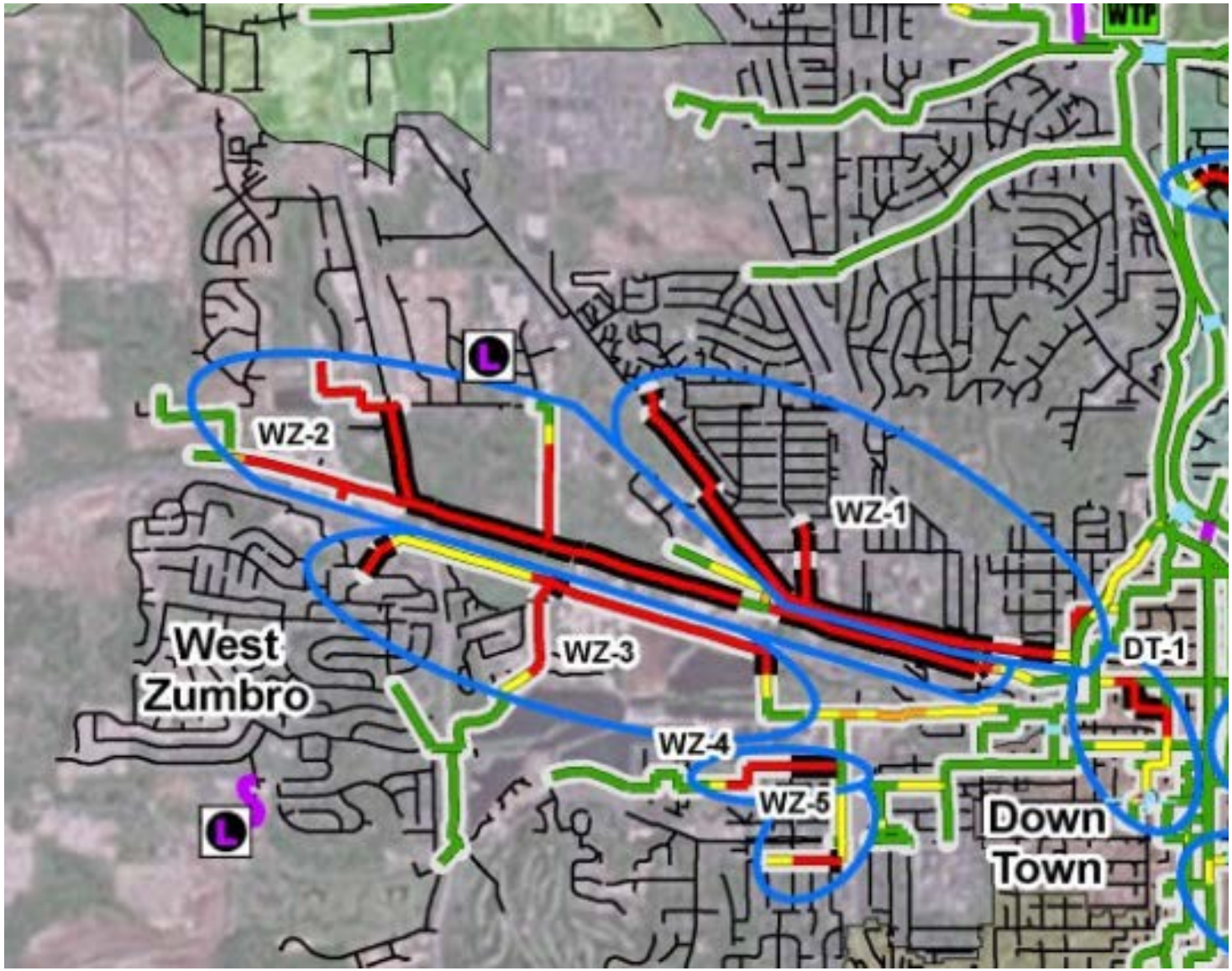
- Trunk sewers with limited capacity identified in West, South, and East Zumbro sewersheds
- System capacity compromised by the impact of infiltration and inflow of surface and groundwater into sanitary sewers
  - Dry weather flows
  - Wet weather flows
- Limited remaining capacity to support future development in some areas




Existing System Capacity Analysis for 25-year Storm

# Existing System Capacity

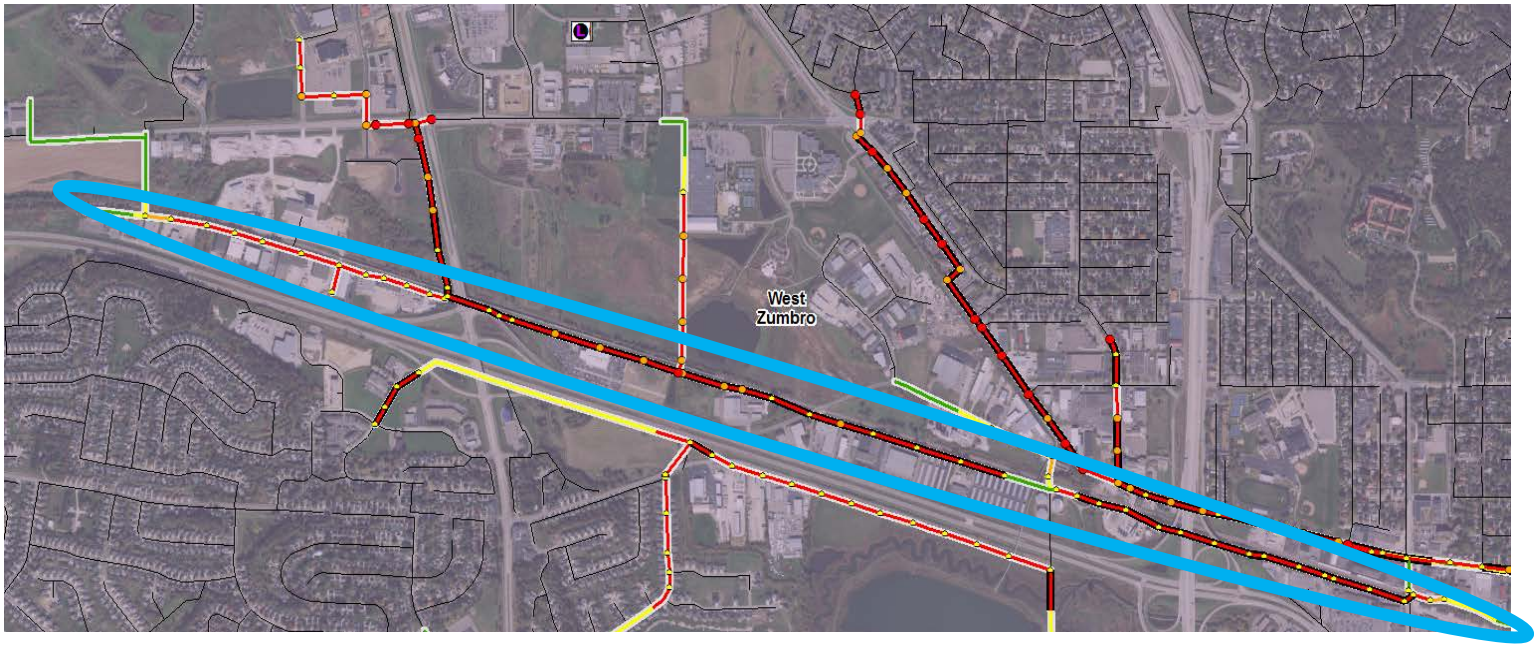
## Example: West Zumbro Super Sewershed



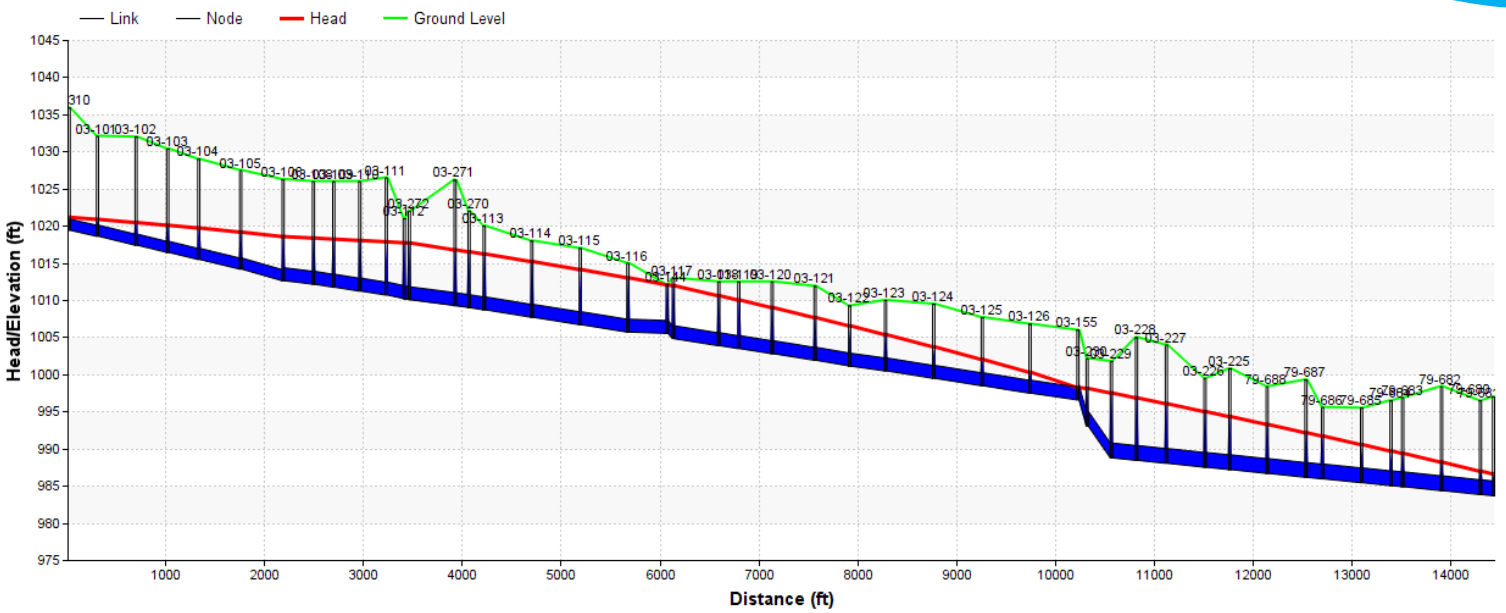

West Zumbro Areas Identified with Capacity Limitations

# Existing System Capacity

## Example: West Zumbro 7th St. NW – W. Circle Drive NW

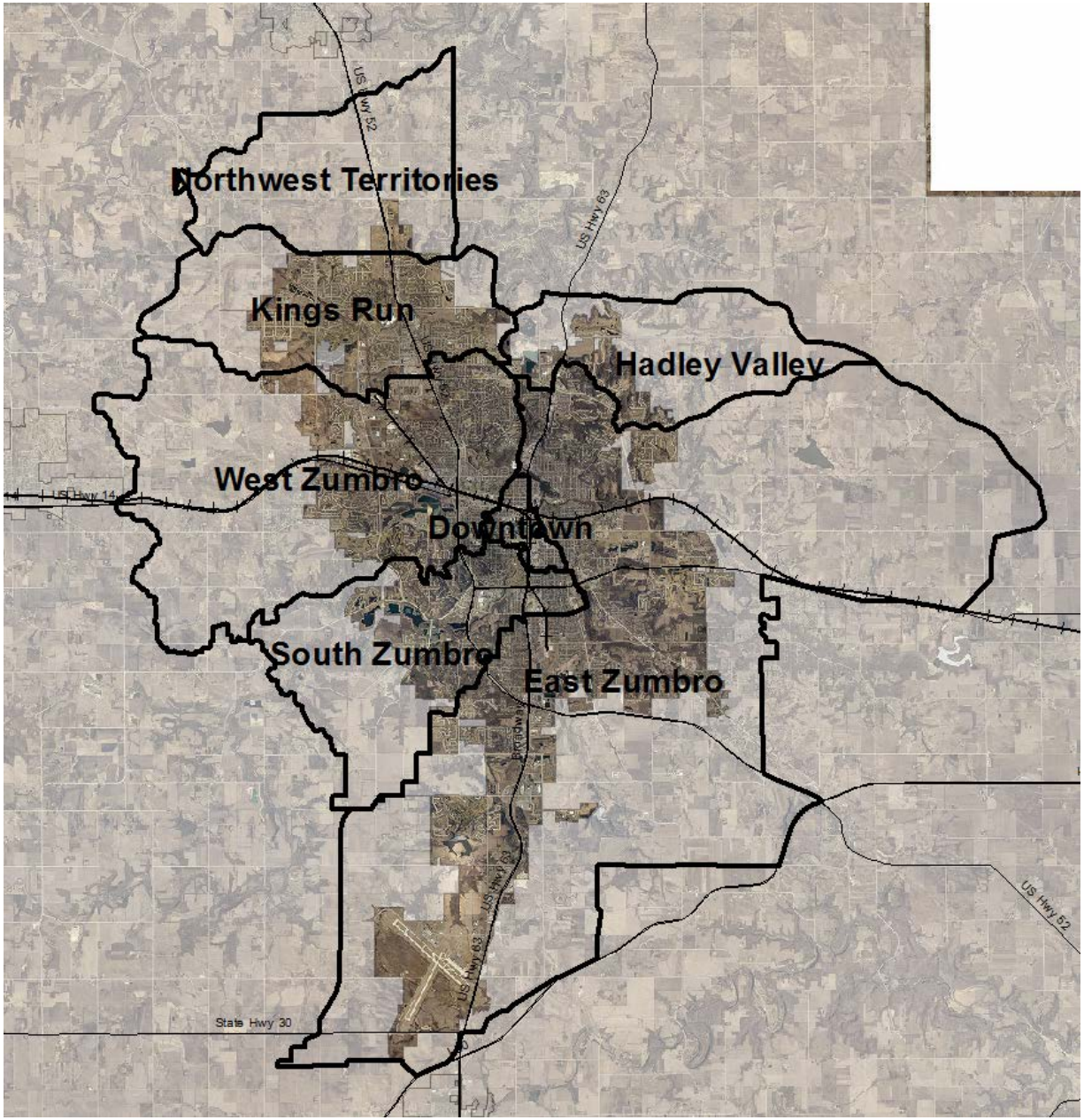



Pipe profile – wastewater level relative to ground and pipe

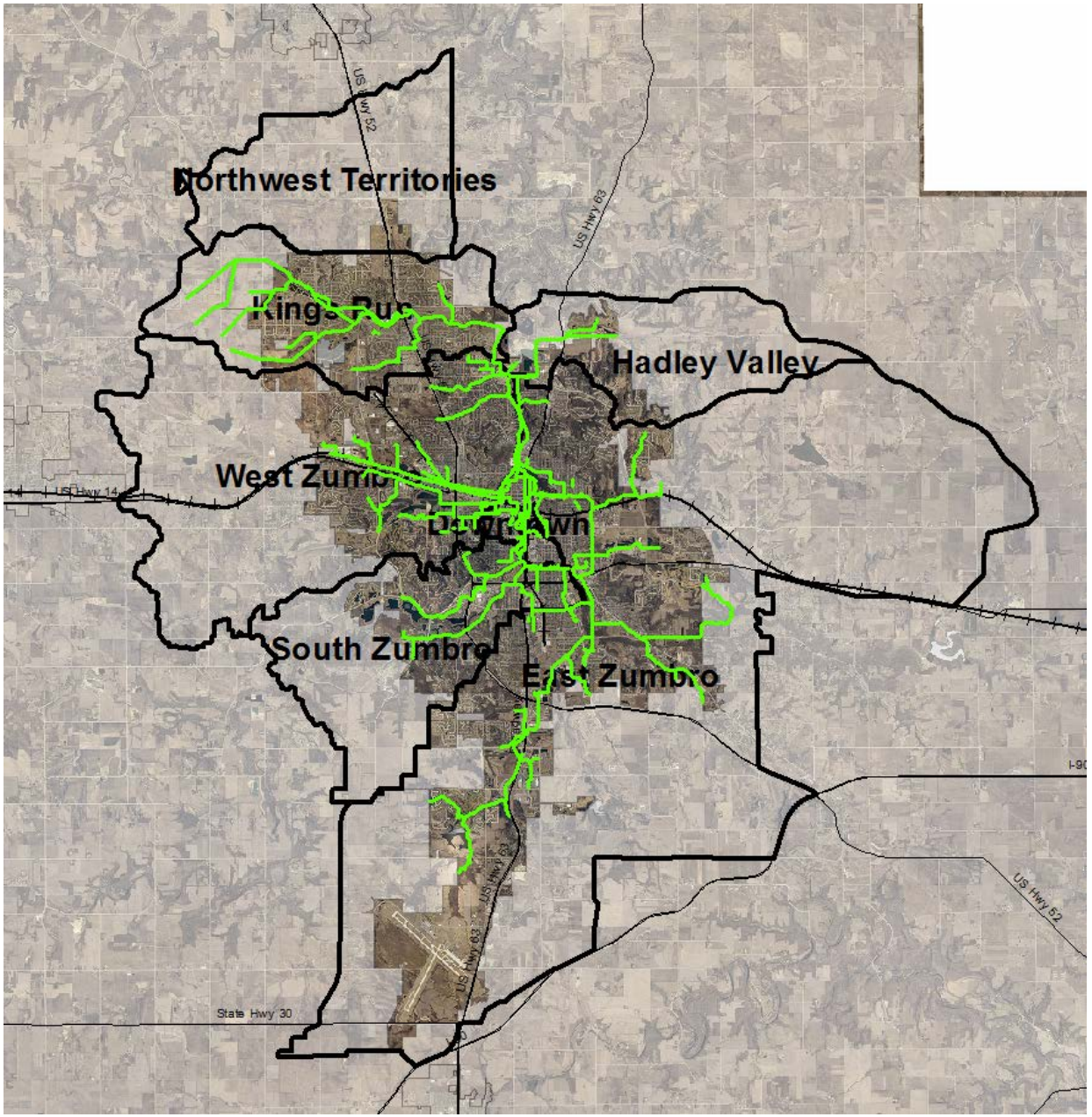


# 02 Study Findings

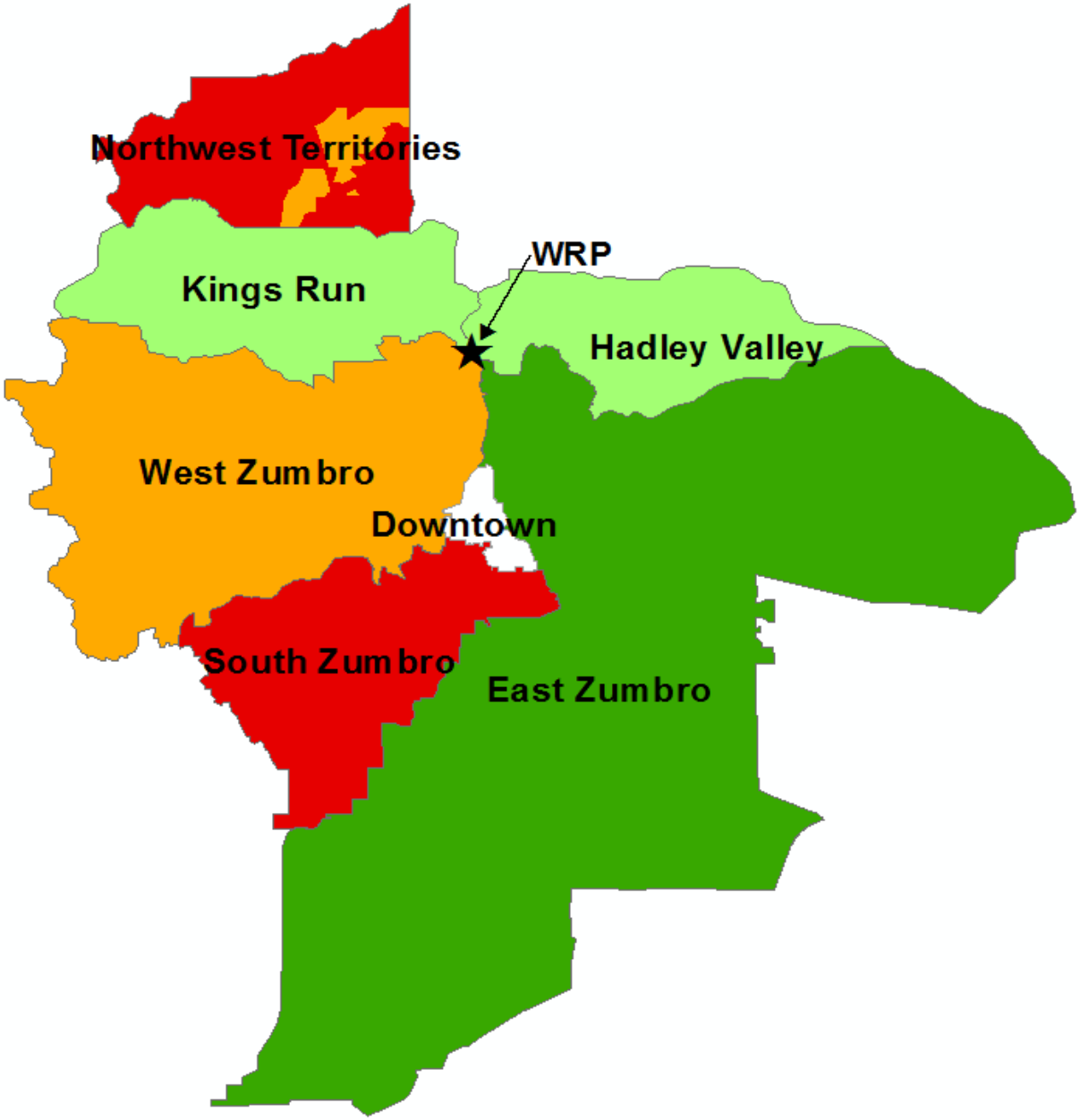
# City Boundary could Grow Significantly and be Served by Gravity Sewer



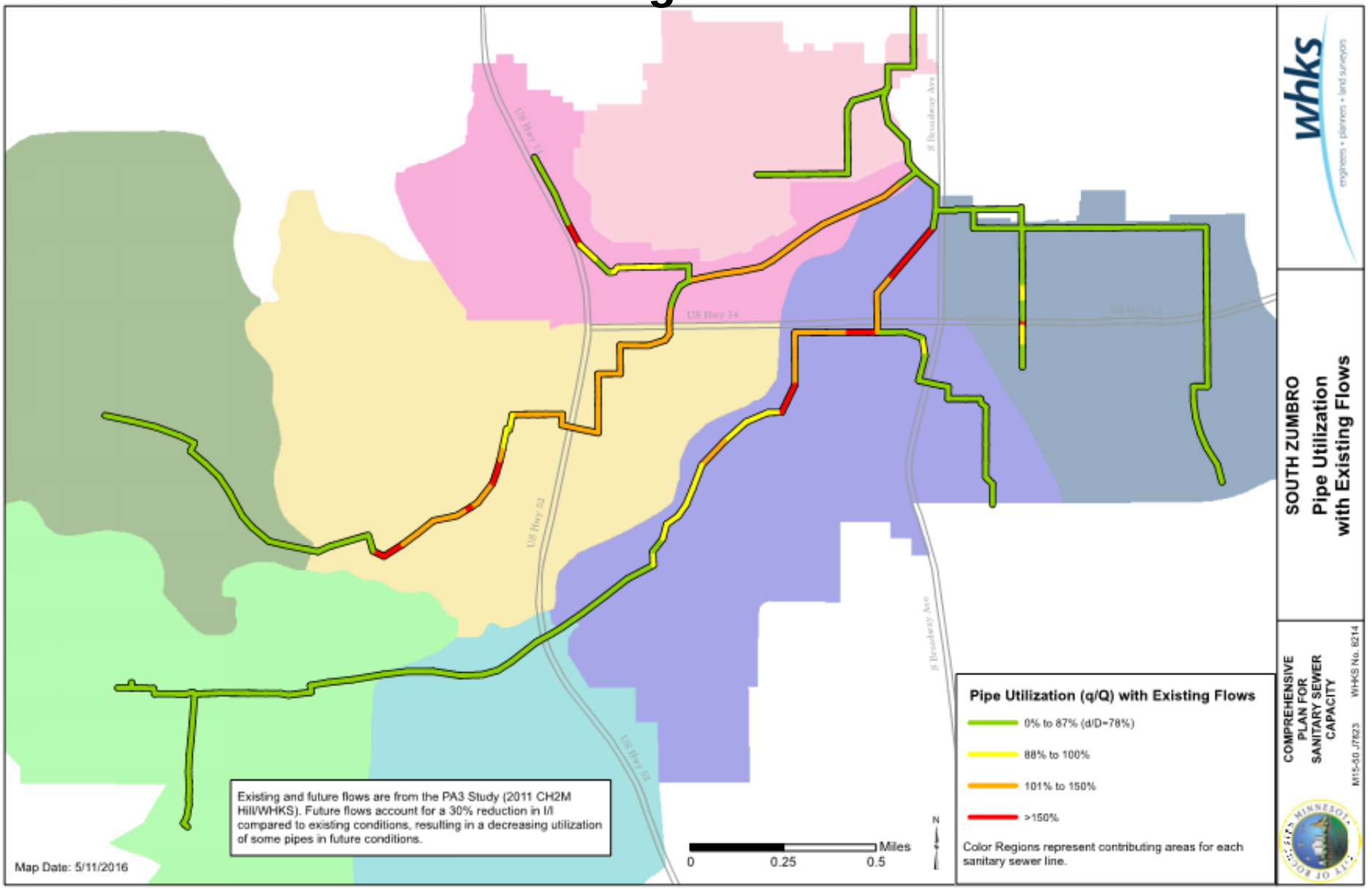
# City Currently has over 500,000 feet of Trunk Sewer Main



# City of Rochester Sanitary Sewer Super Districts

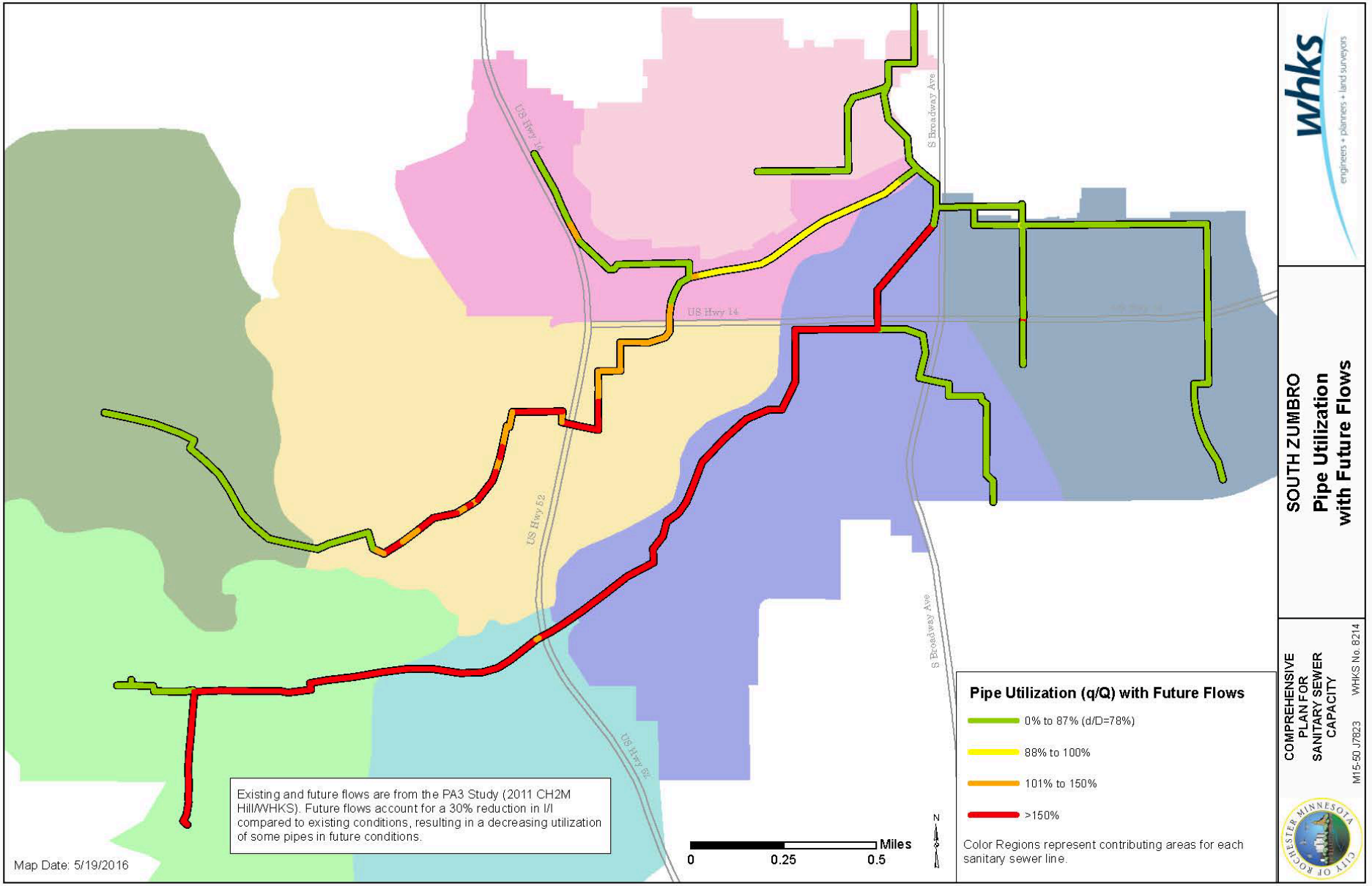


# South Zumbro Under Existing Conditions



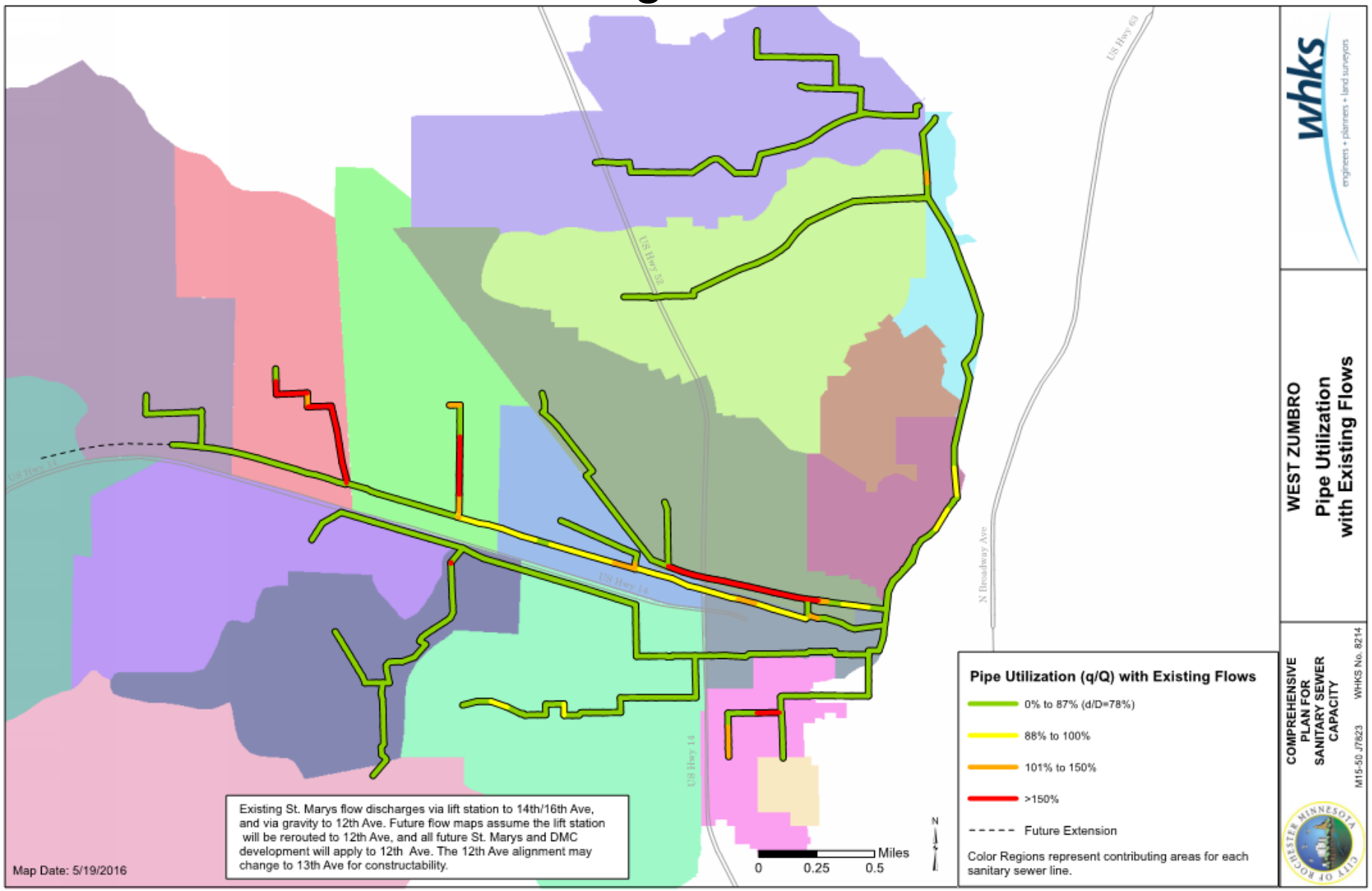

South Zumbro Pipes Are At or Near Full Utilization Under Existing Conditions Leaving Little Capacity Available for New Development

# South Zumbro Under Future Conditions



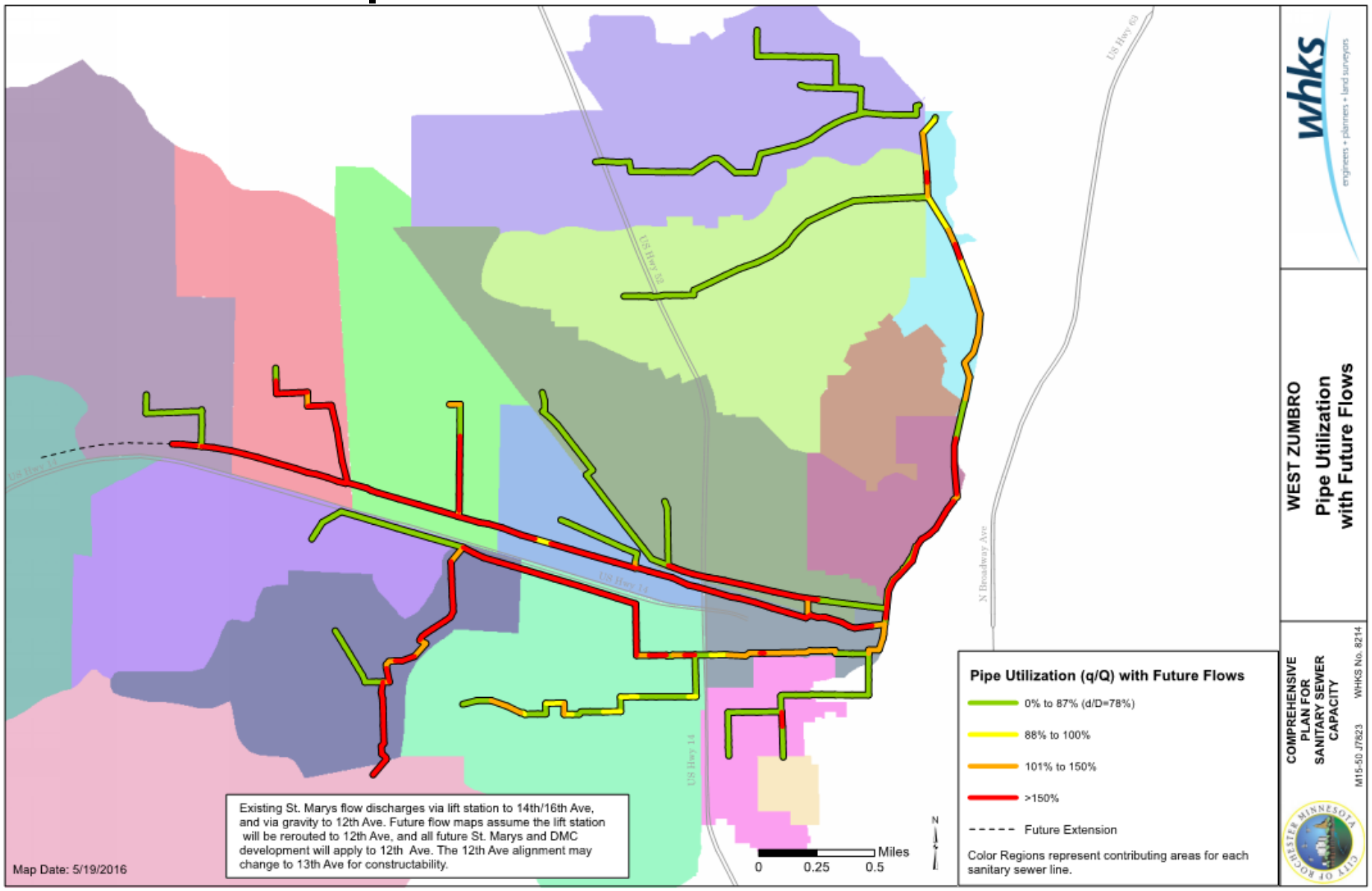

Development in South Zumbro Would Require Upsizing of Pipes South of HWY 14 E at a cost of $11,900,000 and open up 1,244 developable acres…Planning Rate is high at $9,566/dev. ac.

# West Zumbro Under Existing Conditions




West Zumbro Pipes Are At or Near Full Utilization Under Existing Conditions Leaving Little Capacity Available for New Development

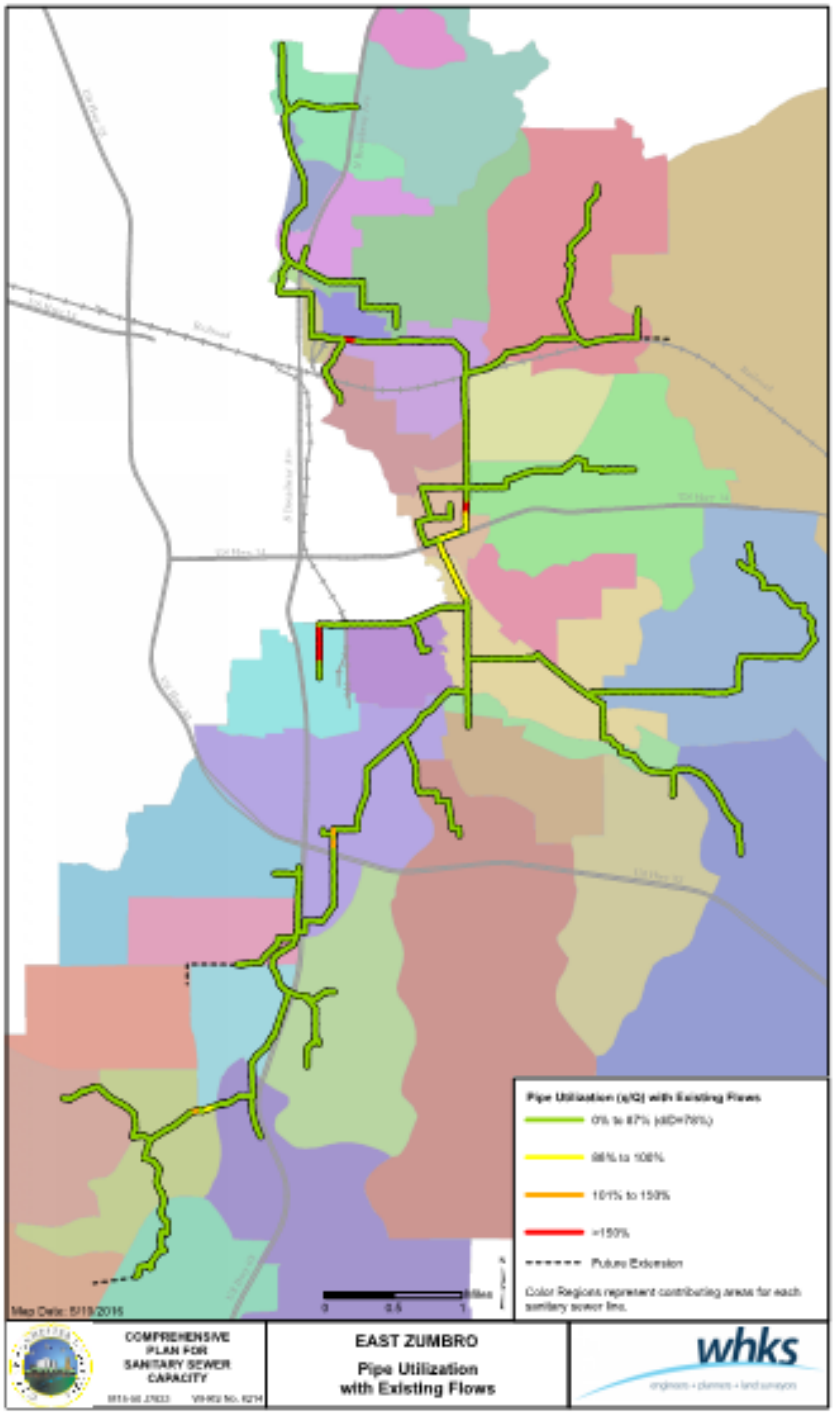
# West Zumbro Pipe Utilization with Future Flows




Development in West Zumbro Would Require Upsizing Pipes Along HWY 14 and Cascade Creek - $39,400,000+ to open 5,241 developable acres…$7,510/dev. ac.

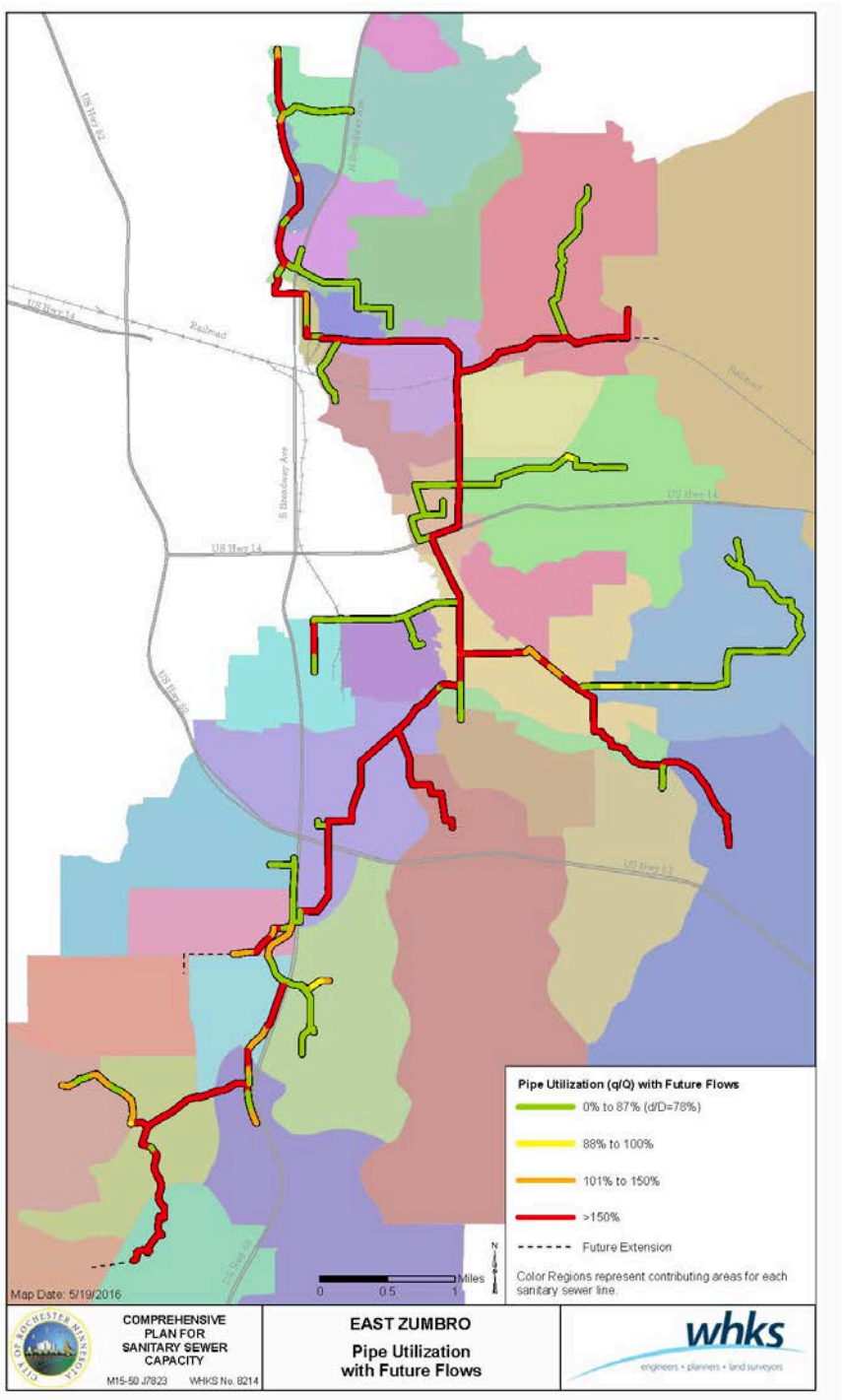
# East Zumbro Under Existing Conditions

East Zumbro pipes appear to have adequate capacity under existing dry weather conditions



# East Zumbro Under Future Conditions

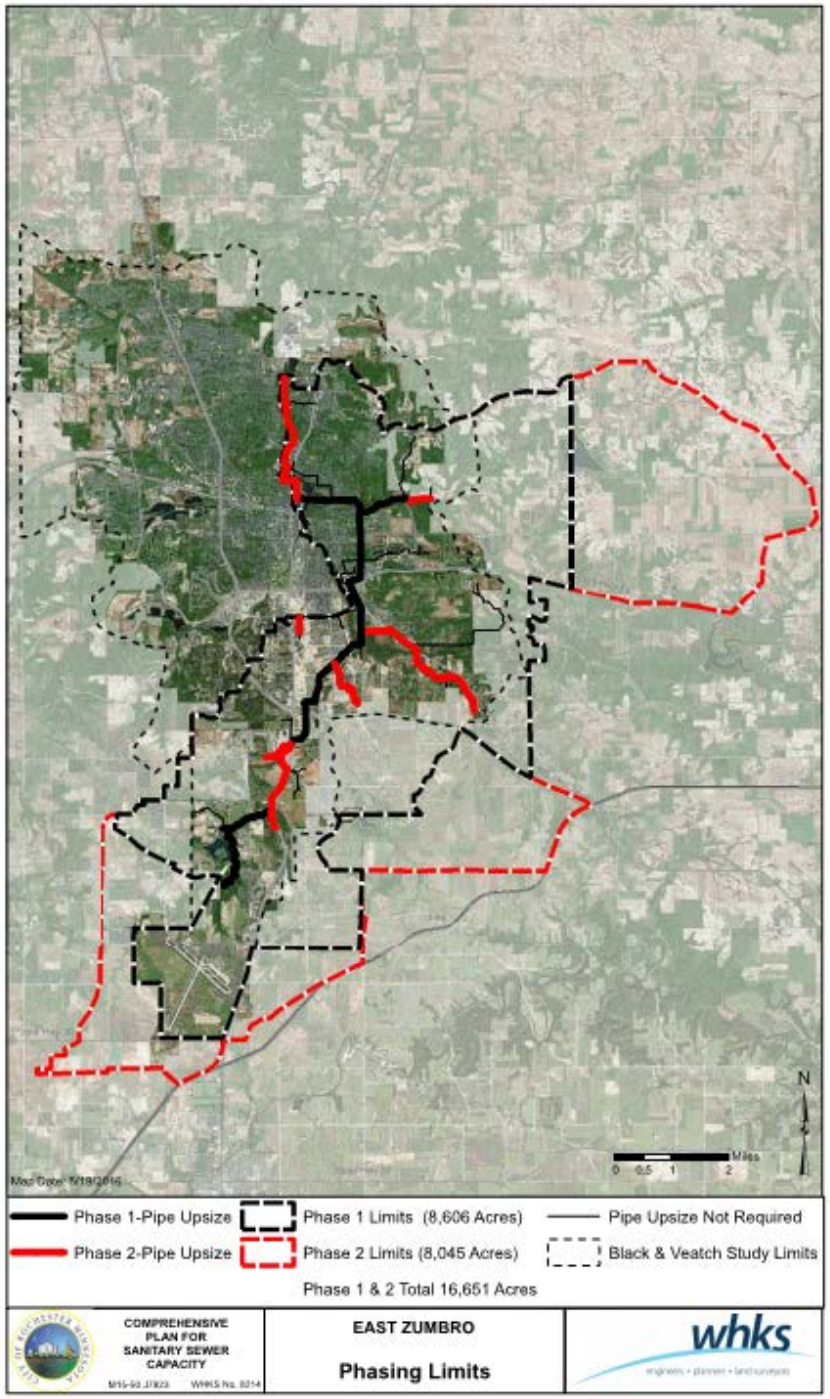
Development in East Zumbro to Ultimate Service bounds would require significant upsizing of pipes - $89,000,000+



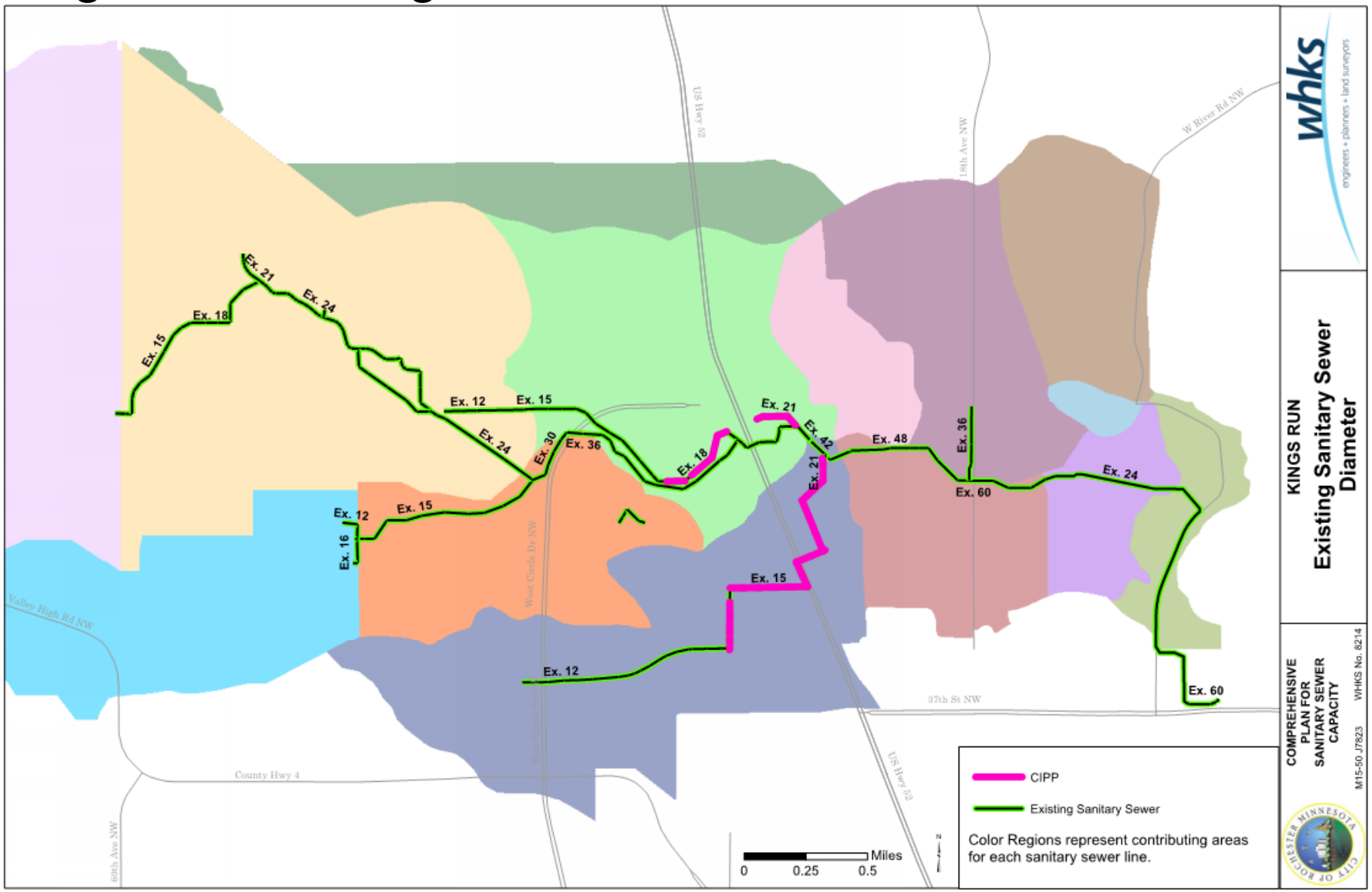
# East Zumbro Phases

A ‘phased’ approach fully utilizes the existing trunk line before further expansion

- Phase 1: $47,900,000 opens 8,606 dev. acres …$5,568/dev. acre
- Phase 2: $41,200,000 opens 8,045 dev. acres … $5,120/dev. acre

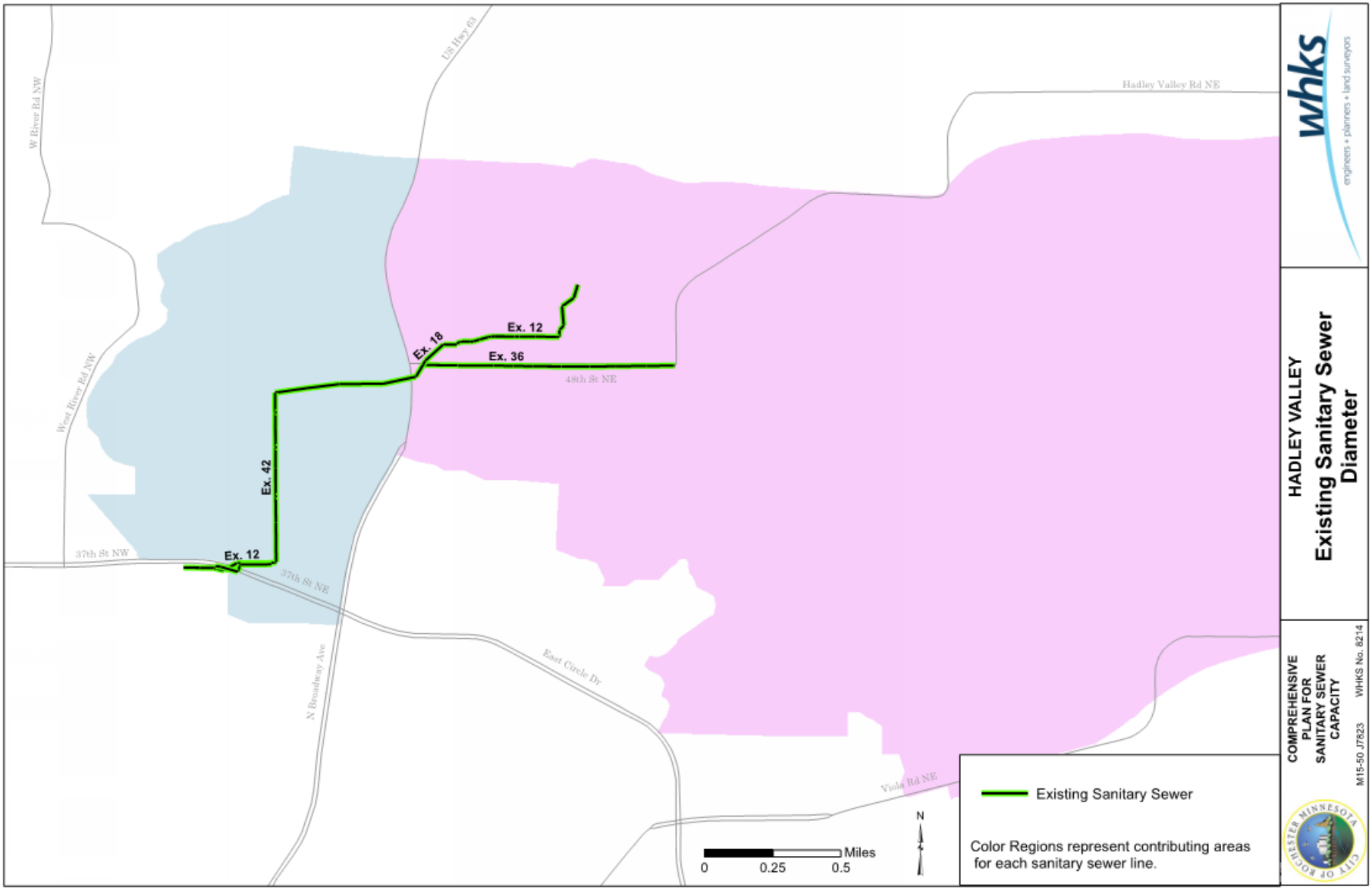


# Kings Run Existing Sewer is Sized for Future Conditions




Kings Run's existing sewer can support full buildout of 4,094 developable acres.
Outstanding balances of existing sewer yield lowest planning rate $1,514/dev. ac.

# Hadley Valley Existing Sewer is Sized for Future Conditions




Hadley Valley's existing sewer is sized to support full buildout of 2,579 dev. acres. Outstanding balances on existing sewer yield Planning Rate low $3,311/dev. ac.

# Northwest Territory

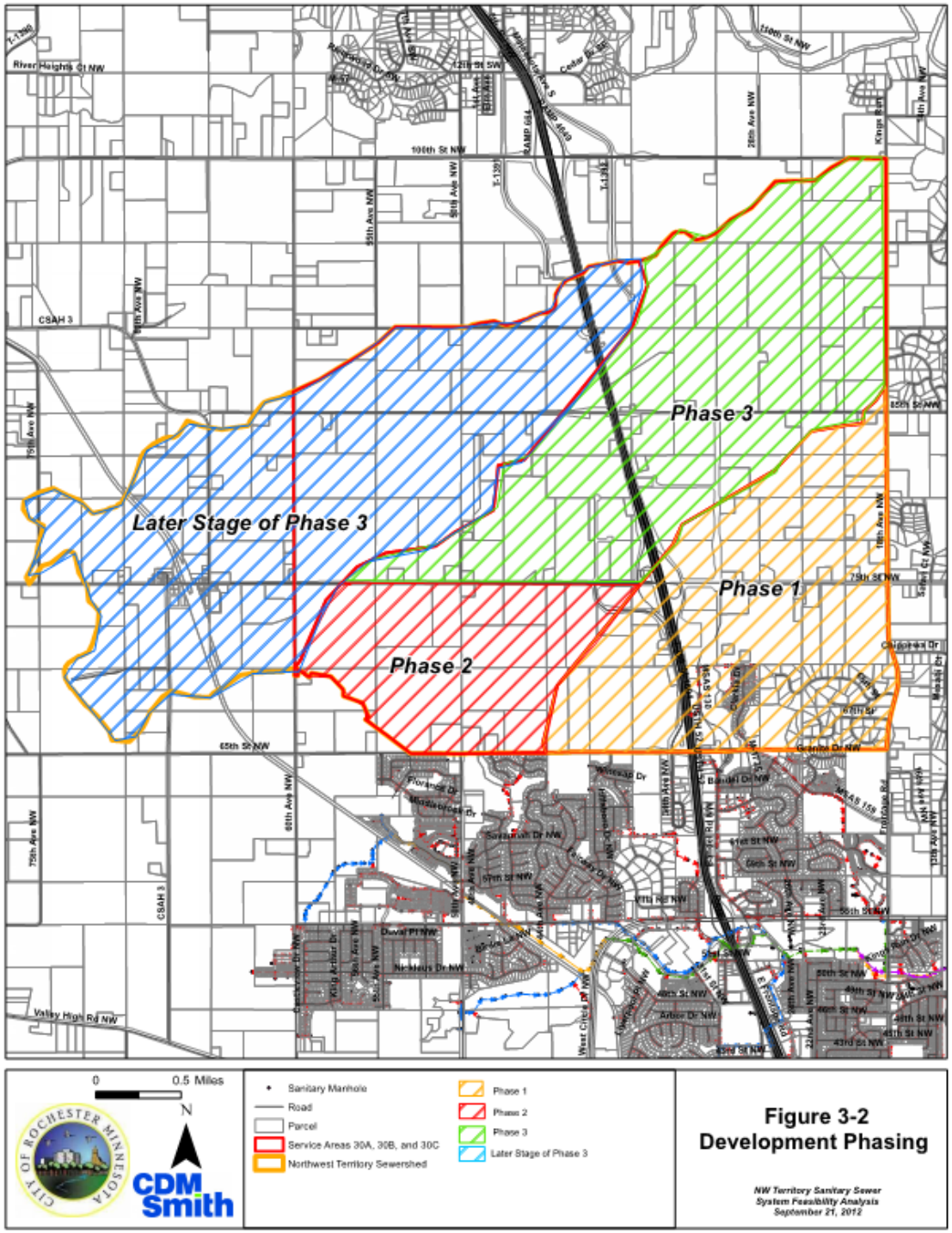
Northwest Territory is
90th St NW to 65th St NW
60th Ave to 18th Ave NW

(90th St to 100th St future)
(60th Ave to 75th Ave future)

7,300 gross acres
2,800 developable acres

Cost to serve Northwest Territory is ~$39,500,000.

SAC charge would be $13,000/developable acre,
($16,000/dev acre counting downstream capacity improvements)…
double other super sheds.

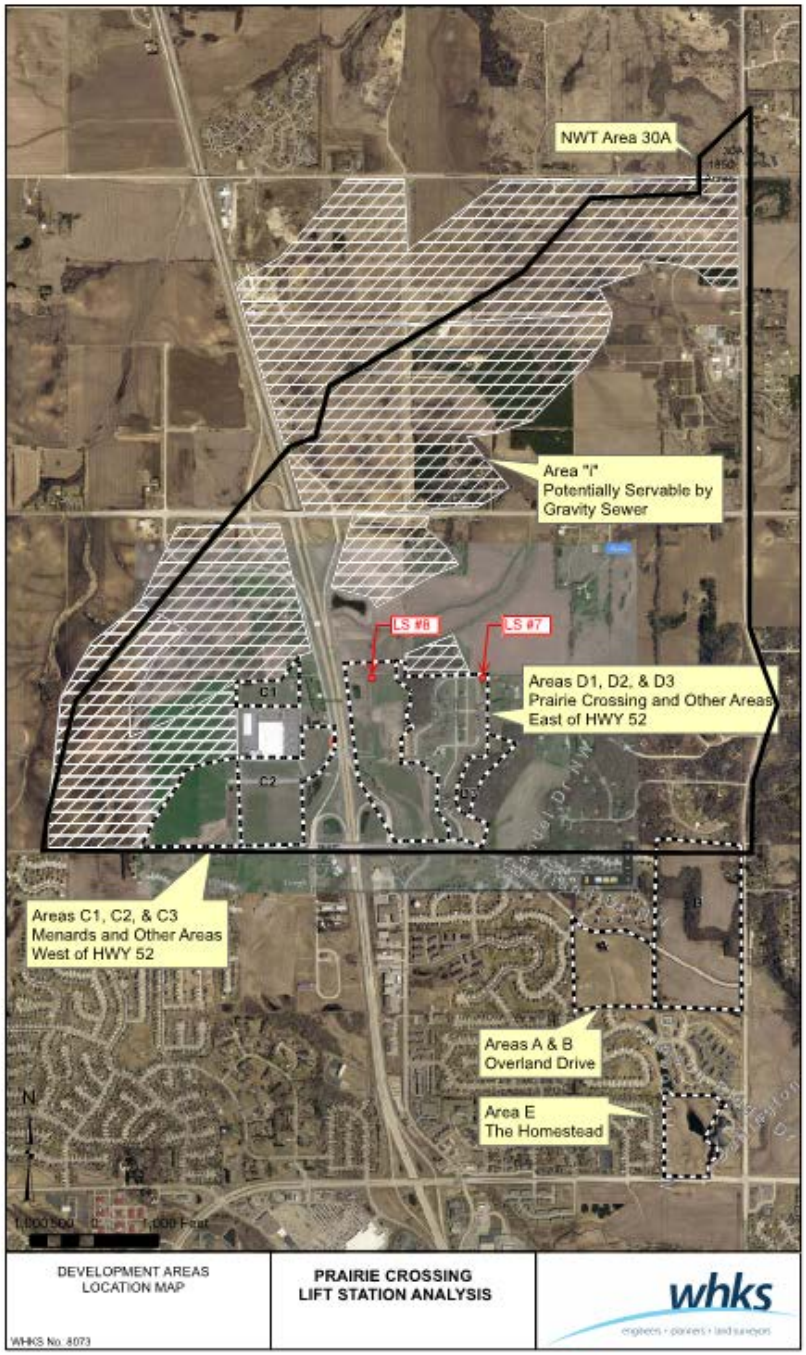


# Portion of Northwest Territory Potentially Served by Existing Prairie Crossing Lift Stations

Existing lift stations and trunk could be modified to serve up to 1,000 gross acres (480 developable acres) of Northwest Territory ‘Phase A’.

Cost to modify is ~$3,700,000

…reducing planning rate of these 480 developable acres to $7,700/dev. acre.



# Total Costs to Grow City Sanitary Service are SIGNIFICANT

| Super District | Outstanding Project Balances | Capacity Upgrade Replace. | Condition Upgrade CIPP | Total | Develop-able Acres | Planning Rate |
|---|---|---|---|---|---|---|
| Northwest Territory | $2,350,000 | $1,360,000 | NA | $3,710,000 | 480 | $7,729 |
| Kings Run | $5,670,000 | NA | $530,000 | $6,200,000 | 4,094 | $1,514 |
| Hadley Valley | $8,540,000 | NA | NA | $8,540,000 | 2,579 | $3,311 |
| West Zumbro | $1,140,000 | $35,540,000 | $2,680,000 | $39,360,000 | 5,241 | $7,510 |
| South Zumbro | $740,000 | $10,320,000 | $840,000 | $11,900,000 | 1,244 | $9,566 |
| East Zumbro Phase 1 | $8,150,000 | $37,250,000 | $2,520,000 | $47,920,000 | 8,606 | $5,568 |
| East Zumbro Phase 2 | NA | $41,190,000 | NA | $41,190,000 | 8,045 | $5,120 |
| Total | $26,590,000 | $125,660,000 | $6,570,000 | $158,740,000 | 30,289 | $5,241 |

*Note: Acres for NW Territory reflect approximate developable acres from modifying existing lift stations, not the entire NW Territory.

# Existing System Modeling Outcomes

- Identified sewer capacity limited trunk sewers and areas
- Identified priority areas for future conditions evaluations
- Developed recommendations for next steps including:
  - Identified areas for additional flow monitoring
  - Identified potential areas for I/I reduction to reduce flows

*Existing system constraints emphasized the need for evaluating potential future development impacts*

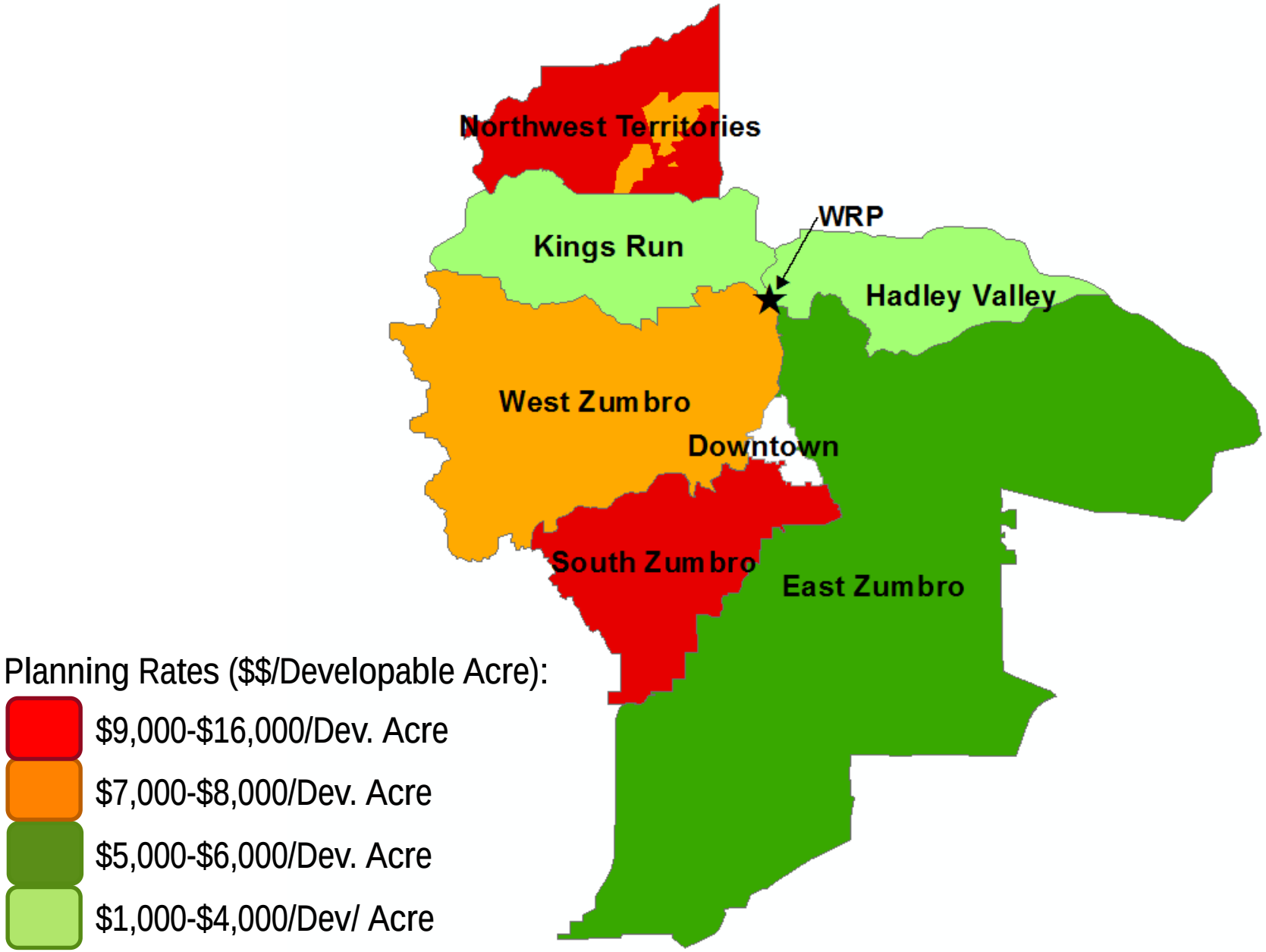
# 03 City Comprehensive Plan and the Impacts of Sanitary Sewer Capacity

# Analysis of Available Sanitary Sewer Capacity Impacts the Comprehensive Plan

- In 2015 a quick, high level look at the capacity of the sanitary sewer system.

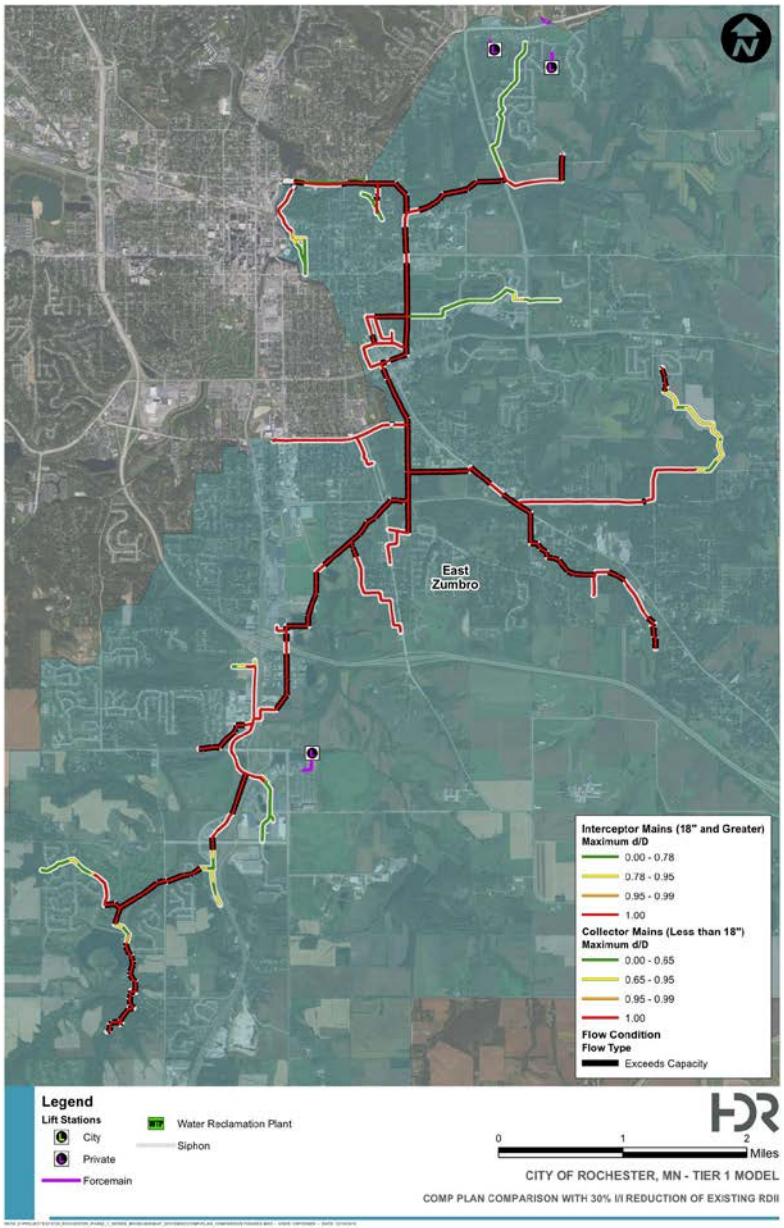
- In 2016 a collaborative, strategic comprehensive analysis done consistent with the City's Comprehensive Plan in an effort to assist the Planners in decision-making and identifying sewer capacity availability and limitations that may guide future investments in the trunk sewer system.

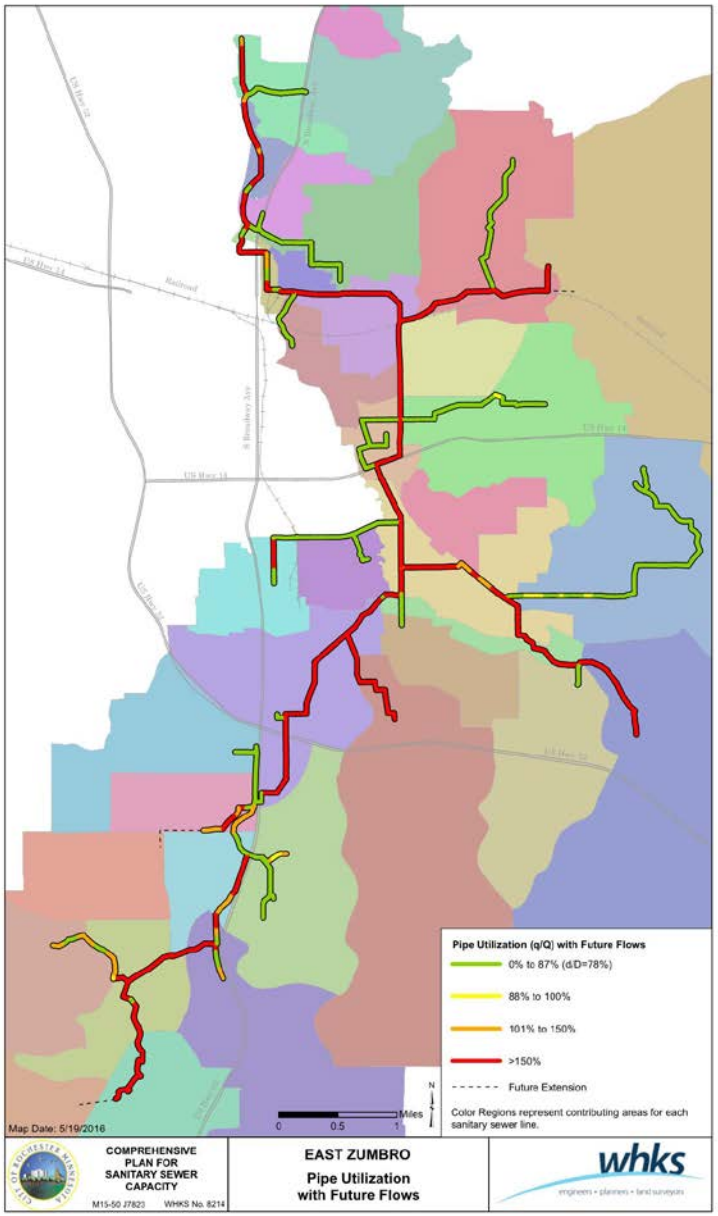
# City of Rochester Sanitary Sewer Super Districts



# Comparison of Model with Comprehensive Plan Analysis

## East Zumbro Future Development – September 2010 Storm



# Key Outcomes to Support Comp Plan Decision-Making

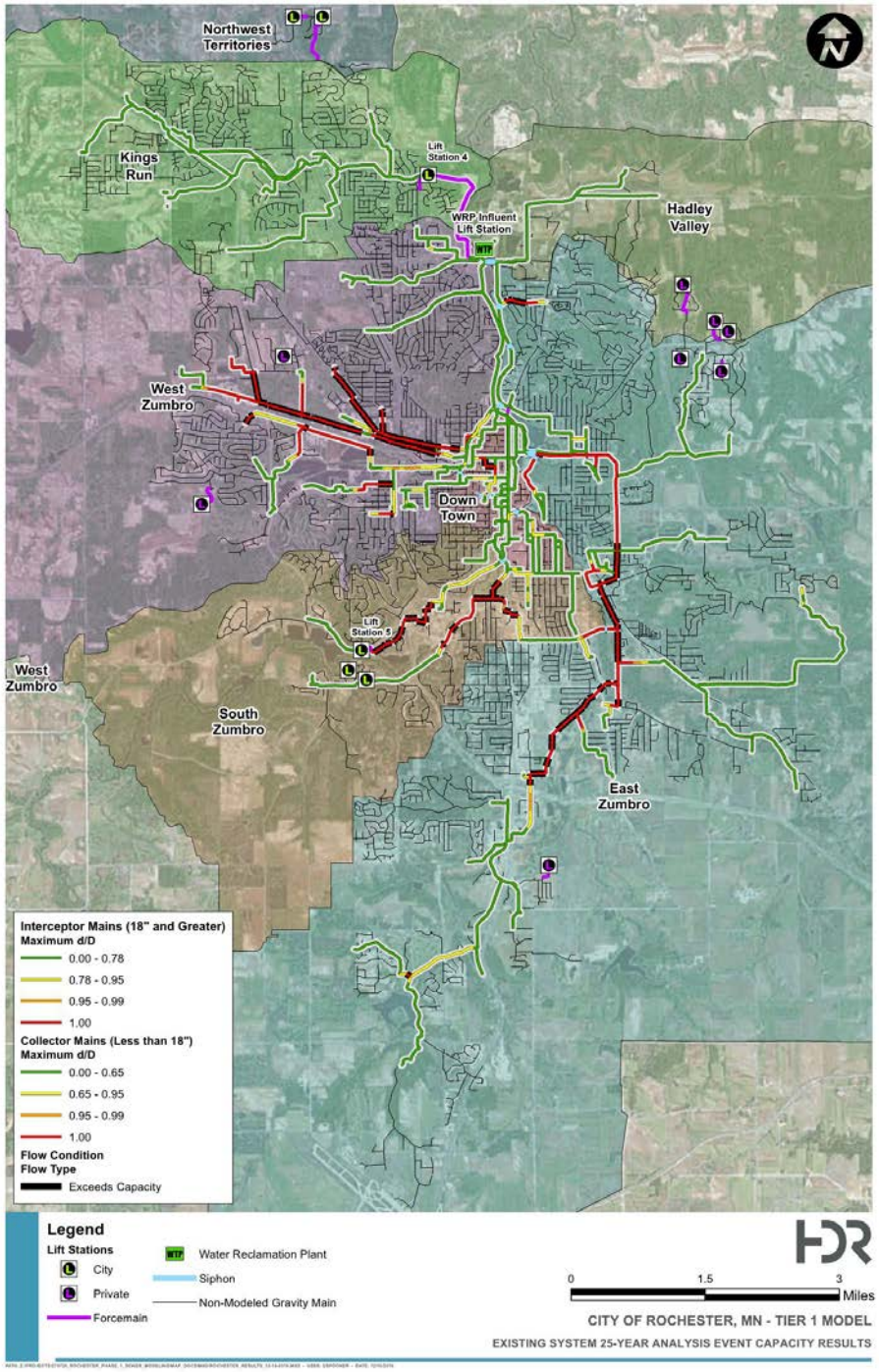
- Establish Super Sewershed SAC Planning Rates
  - New development in the Hadley Valley and Kings Run Super Sewersheds is the most cost effective (lowest SAC and City investment) from trunk sewer service perspective
- Estimated future infill & new development acres able to be served by existing trunk sewers before needing upgrades.
  - Infill development that utilizes existing pipes = no extra sewer cost
  - Key projects open bottlenecks that open up developable acres
- Identified the need for Trunk Sewer Capacity and Condition Upgrades
  - Capacity upgrades needed to serve future sewer-shed development

# 04 Next Steps

# Near Term Tasks

- Downtown model expansion – include Tier 2 (all pipes < 12”) in DMC area
- South Zumbro and Downtown Future conditions analysis (including DMC)
- East Zumbro, South Zumbro, and Downtown (including DMC) CIP improvement planning for future development

*Develop improvement priorities and recommendations, including costs and trigger points, to optimize City’s capital improvement schedule and budget*



# Long Term Goals

- West Zumbro, Hadley Valley, Kings Run, and NW Territories
  - Future conditions
  - CIP Improvement planning for development
- Citywide model enhancement – include all pipes (add pipes < 12”)
- Consolidate super-sewershed ‘building blocks’ into comprehensive sewer master plan

*Develop City-wide sanitary sewer master plan to inform CIP and optimize City investments*

# Additional Model Uses

- Development plan reviews
- Robust planning tool – predictive ‘what-if’ scenarios
- Real-time system monitoring and forecasting
- Forensic and predictive sewer analysis
- Optimize sewer and treatment plant O&M strategies